DESIGN FOR A MALAISE TRAP

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In 1937, Dr. René Malaise of Stockholm published an account of a novel insect trap, with construction plans (Ent. Tidskrift 58: 148-160). The trap was a tent-like structure of fine netting, into which flying insects would wander, and their natural tendency to work upwards when trying to escape would eventually pass them into a collecting apparatus at the top of the trap. This type of trap merits more development and use than it has had. The design and construction details presented below describe a model used by the author since 1959. An example of the model was exhibited at the Annual Meeting of the Entomological Society of America at Detroit, in December, 1959. Since then there have been many requests for plans of the trap, which resulted finally in the preparation of this paper.

It should be understood that the Malaise trap is capable of endless modification for convenience of construction, and for adaptation to particular types of insects and particular habitats. The design below is presented with some hesitation, as its publication might tend to freeze the model at this stage of development rather than encourage further experimentation with it. This model was developed for catching Ichneumonidae, for which it works very well. It also catches all other kinds of actively flying insects, particularly Diptera, Hymenoptera, and Lepidoptera. The types of insects caught depend to a large extent on where the trap is set. Modifications of its size, shape, baffle arrangement, and collecting assembly would influence the quantity and relative proportions of various species collected, and the color of the trap would also have some effect. All these factors need further experimentation. The present trap measures six feet square and almost eight feet high.

Plans for another type of Malaise trap have been published by Gressitt and Gressitt (1962, Pacific Insects 4: 87-90). In comparison with the design described below, this model is much more portable and easier to make, but is possibly less efficient for some kinds of insects. The Gressitt design is basically a good one and merits further development. It could probably be improved by making more upward slope along the top edge into the collecting chambers at each side, reduction of the expanse of the trap but not of the side and top baffles, use of a more transparent type of netting, and elimination of the darkened areas in the collecting cones caused by doubling of the netting where it is tied to the plastic collectors. A greater capacity for the plastic collecting chambers would also be of advantage.

The Malaise trap can be to students of flying insects what the Berlese funnel has been to students of soil arthropods. It will gather

[1]This paper is an incidental result of research supported by the Dow Chemical Company, National Institutes of Health, and National Science Foundation.

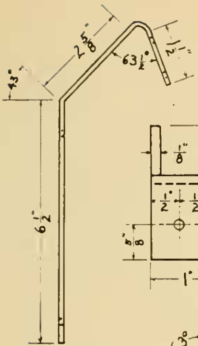
large numbers of elusive species. It can operate almost anywhere, including places that are not easily accessible, or where the briefness of favorable weather or the paucity of the fauna would discourage the ordinary collector. It can work efficiently in mosquito-infested localities where a collector would not stay for long, and it can be

hoisted to the tree tops to collect the high flying insects which have never been adequately sampled. It collects with equal efficiency in sun, rain, or at night. Only temperatures too low for insect flight will stop its operation.

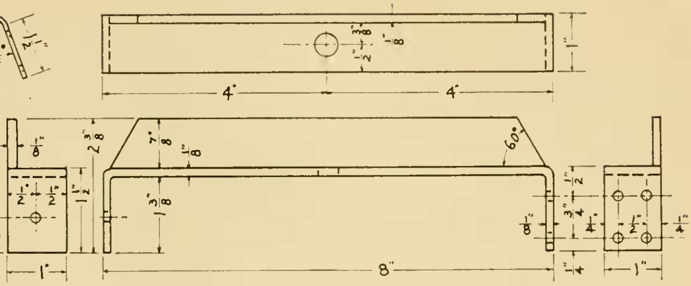
The ecologist can use Malaise traps for sampling insect faunas that have previously been very inconvenient to study. Although such samples do not measure populations in terms of numbers per unit area, they are objective and can be standardized for comparisons from one locality to another and from one part of a season to another. Since the traps do not actually attract insects, they can be used for sampling the faunas of small areas. The only commonly used collecting device with similar capabilities is the rotary trap.

Probably specially designed Malaise traps will eventually prove to be efficient control measures for a few kinds of insect pests. Some of the most likely prospects are Tabanidae.

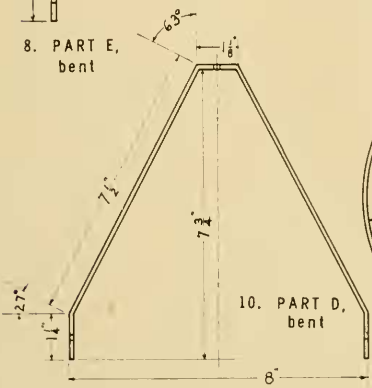
Below are lists of materials for constructing one trap, and the tools needed. Then follows a list, with drawings, for the more complex parts, directions for assembly, and finally operating instructions.



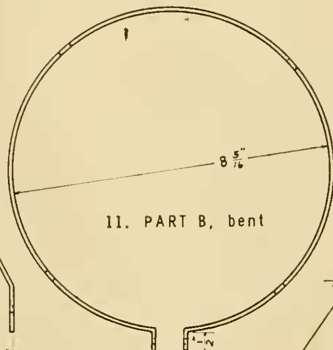
8. PART E, bent



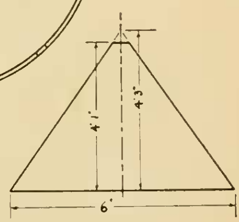
9. PART G, side, top, & 2 end views



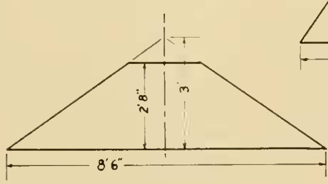
10. PART D, bent



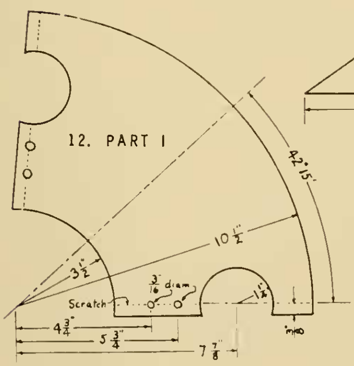
11. PART B, bent



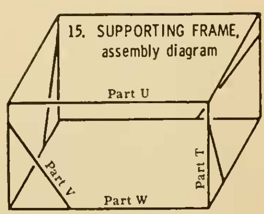
13. PART M



14. PART N



12. PART I

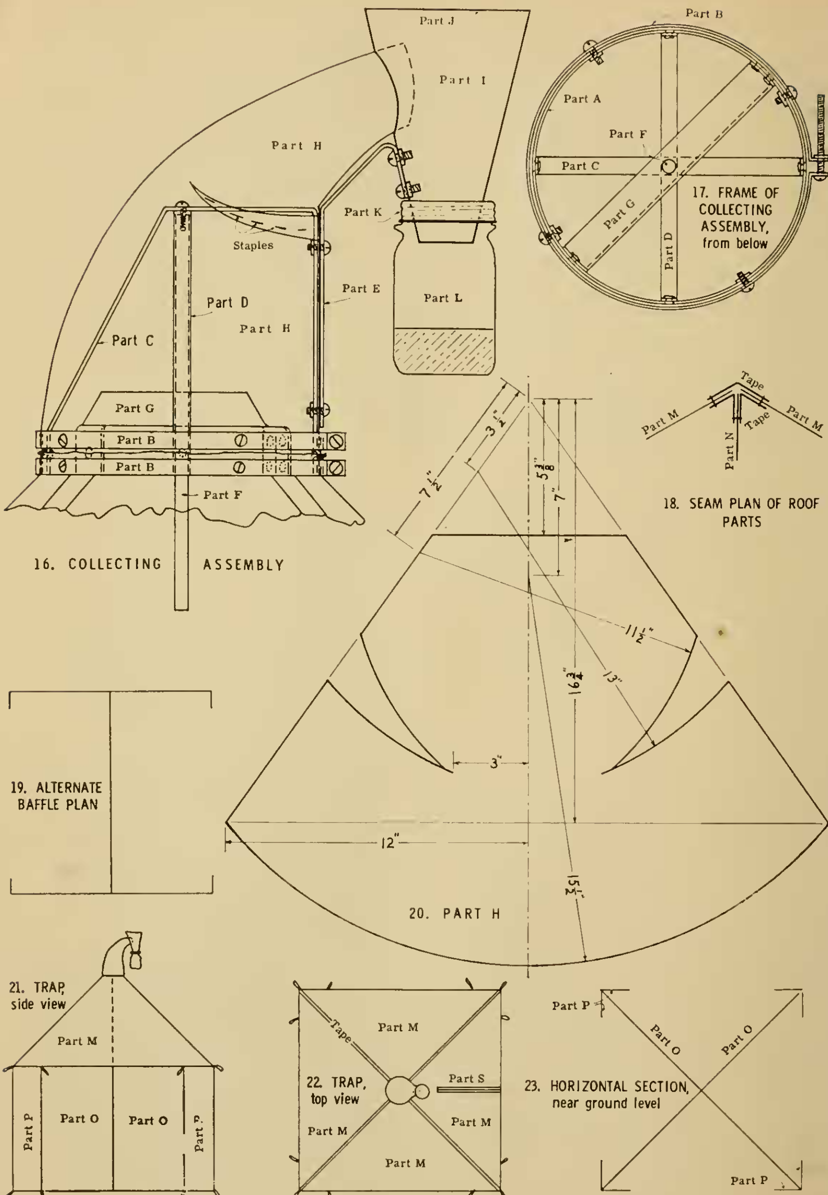


15. SUPPORTING FRAME, assembly diagram

Materials List

Dry goods.—

White netting 49 inches wide, 4 yards long; another piece 32 inches wide and 3 yards long. The netting should be strong, and with 18 to 30 mesh per linear inch. Probably the best material is saran. Saran netting is available from



16. COLLECTING ASSEMBLY

17. FRAME OF COLLECTING ASSEMBLY, from below

18. SEAM PLAN OF ROOF PARTS

19. ALTERNATE BAFFLE PLAN

20. PART H

21. TRAP, side view

22. TRAP, top view

23. HORIZONTAL SECTION, near ground level

Chicopee Manufacturing Corporation, Cornelia, Georgia, as their material no. 1828-000, 36 inches wide, at about 29¢ per running foot. This being narrower than 49 inches, some piecing will be required. Another possible material is dacron. Nylon is not good because it rots rapidly in sunlight, and a trap made of this is good for only one or two seasons of use. In his original design Malaise found cotton bobinet satisfactory.

Black or very dark colored netting, 42 inches wide, 5⅓ yards long. This should be similar to the white netting but black instead of white. A dark olive-green saran netting is sold by the above company as their material no. 1828-002, 36 inches wide, about 27¢ per running foot.

Black muslin cloth, 2 pieces 10 inches wide, 8½ feet long.

White or colored binding tape, 1 inch wide, 25 yards.

Zipper, approximately 30″ long.

Cotton thread, no. 50, one large spool.

Cord, 1/8 to 3/16 inch diameter, 28 inches.

Cord, any strong cord, 4 yards.

Hardware.—

Aluminum strips, ⅛″ thick.
- 1¼″ wide, 25¼″ long; 1 piece
- ¾″ wide, 11⅛″ long, 1 piece
- ½″ wide, 27″ long; 2 pieces
- ½″ wide, 21⅞″ long; 1 piece
- ½″ wide, 18⅝″ long; 1 piece

Angle iron, 1 inch on each side, ⅛″ thick, 1 piece 10½″ long.

Iron rod, ⅜″ diameter, 11½″ long.

Stove bolts, 3/16″ diameter, ½″ long; 13 pieces, with 12 nuts.

Stove bolts, 3/16″ diameter, 2½″ long; 26 pieces, with nuts.

Galvanized wire screening, about 18 mesh to linear inch, 1 piece 18″ x 24″.

Aluminum rivets with beveled heads for countersinking, 3/16″ diameter, ⅜″ long; 9 pieces.

Heavy gauge staples for stapling machine, about ⅜″ wide and ¼″ long; 20 pieces.

Softwood (pine, fir, or spruce).—

8 pieces ¾″ x ¾″ x 50″. These can be sawn from a ¾″ board 7½″ wide and 50″ long, if there is no wastage to avoid knots.

4 pieces ¾″ x ¾″ x 76½″. These can be sawn from a ¾″ board 3¾″ wide and 76½″ long, if there is no wastage to avoid knots.

4 pieces ¾″ x 1¼″ x 76½″. These can be sawn from a ¾″ board 5½″ wide and 76½″ long, if there is no wastage to avoid knots.

1 piece 1⅛″ x 1⅛″ x 82″. This can be sawn from 1¾″ x 3¾″ stock.

Miscellaneous.—

Clear cellulose acetate plastic sheet, 0.05 inch thick. One piece 9″ x 15″ and 1 piece 5¼″ x 5¼″. Probably other kinds of clear plastic would also be satisfactory.

Acetone (ethyl ketone), 3 oz. If another kind of plastic, not soluble in acetone, is used, substitute a solvent for the plastic employed.

Rust proofing paint primer, 2 oz.

Screw-cap jar, pint size, 2⅜″ mouth diameter, either empty if alcohol is to be used in running the trap or made into a cyanide jar if cyanide is to be used.

Metal screw cap for the above jar with a 2-3/16″ hole in the top of the cap (such jar caps are now standard for home canning).

Note: Cost of all materials at present prices is about $28.00.

Tools List

Sewing machine, medium-sized sewing needle, scissors, package of straight pins, soft crayon, yard stick (or ruler), protractor, hack saw, drill with twist bits ⅛", 3/16" and ⅜" for metal and ¼" for wood, screw-tapping set for making 3/16" stove bolt thread (female), center punch, hammer, metal vise, bench saw if wood pieces are to be sawn from boards, tin snips, scroll saw, pocket knife, 3 small c-clamps, screwdriver, small paint brush, brace and ½" wood bit, and sheet of medium fine sandpaper.

Parts List (1 piece each, unless noted otherwise)

A. Aluminum strip ⅛" x 1¼" x 25¼". Drill 3/16" holes as in figure 1. Countersink 9 of the holes (with ⅜" bit) as shown in figure 1 to receive heads of rivets. Then bend into a complete circle as shown in figure 17.

B. Aluminum strip ⅛" x ½" x 27". Drill 3/16" holes as in figure 2. The slots 3/16" x ⅜" may be made by drilling adjacent holes and then cutting out the metal between. Turn ½" ends 90° and bend the remainder into a circle as in figure 11. 2 pieces.

C. Aluminum strip ⅛" x ½" x 21⅞" long. Drill 3/16" holes as in figure 3 and bend as in figure 7.

D. Aluminum strip ⅛" x ½" x 18⅝" long. Drill 3/16" holes as in figure 4 and bend as in figure 10.

E. Aluminum strip ⅛" x ¾" x 11¾". Drill 3/16 holes as in figure 5 and bend as in figure 8.

F. Iron bar, ⅜" diameter, 11½" long. Drill hole ½" deep in one end with ⅛" bit, then tap it with a female 3/16" stove bolt thread. See figure 6.

G. Angle iron, 1 inch on each side, ⅛" thick, 10½" long. Cut, bend and drill as in figure 9. The central hole is ⅜", to receive the ⅜" iron bar (part F). The other holes are 3/16".

H. Galvanized screening. Cut to shape shown in figure 20. Make the pattern first with paper, lay the pattern on the screening, and cut with tin snips.

I. Cellulose acetate sheet, 0.05 inch thick. Cut to shape shown in figure 12. This can best be done by first drawing the pattern on paper, and laying the plastic over the paper for copying. Mark the plastic with scratches, using a sharp nail against a ruler for straight lines and the point of dividers for the arcs. Make the scratch near each outside edge as shown in the drawing, mark the outside edges ⅜" from these scratches, and mark the centers of the 3/16" holes. Cut the straight lines of the outline, and the outside curve with tin snips. Cut the inside curves close to their scratches with a scroll saw and trim up to the scratches with a pocket knife. Drill the 3/16" holes with a metal drill. Save the plastic trimmings and soak some of them in acetone to make a glue for assembling the plastic parts.

After cutting is completed, soak the plastic in almost boiling water to soften it and work it into as nearly perfect a cone as possible (see figure 16), with the two submarginal scratches exactly overlapping.

J. Cellulose acetate sheet, 0.05" thick. 1 piece 5¼" x 5¼".

K. Top of jar lid. See materials list.

L. Pint jar. See materials list.

M. Top panel for trap. White netting (preferably saran). Cut to shape as in figure 13. The length of the material should be parallel to the 6 foot edge. 4 pieces.

N. Top baffles for trap. White netting (preferably saran), Cut to shape as in figure 14. The length of the material should be parallel to the 8½ ft. edge. 2 pieces.

O. Bottom baffles for trap. Black netting (preferably saran). Cut pieces 8½ ft. x 42″. 2 pieces.

P. Side baffles for trap. Black netting (preferably saran). Cut pieces 20″ x 42″. 4 pieces.

R. Bottom skirt for trap. Black muslin. Cut pieces 8½ ft. x 10″. 2 pieces.

S. Zipper, about 30″ long.

T. Softwood ¾″ x ¾″ x 50″. Uprights for supporting frame. Bore ¼″ holes at ¾″ from first end and at both 1½″ and 7¼″ from second end. Then turn stick 90° and bore ¼″ holes at 2″ from first end and at both ¾″ and 6″ from second end. 4 pieces.

U. Softwood ¾″ x ¾″ x 50″. Braces for supporting frames. Bore ¼″ hole at ¾″ from each end. 4 pieces.

V. Softwood ¾″ x ¾″ x 76½″. Top rails for supporting frame. Bore ¼″ holes at ¾″ from each end. 4 pieces.

W. Softwood ¾″ x 1¼″ x 76½″. Bottom rails for supporting frame. Bore ¼″ holes at ¾″ and at 25″ from each end. 4 pieces.

X. Softwood 1⅛″ x 1⅛″ x 82″. Center pole. Bore ½″ hole in the center of one end, to a depth of 7″.

Assembly

First, give all iron parts (part F, G, K, and stove bolts) a coat of rust proofing paint primer and put aside to dry. On the nuts and bolts the coat should be thin, so as not to gum the threads too much.

Supporting frame: Using 3/16″ x 2½″ stove bolts, bolt together parts T, U, V, and W in the pattern shown in figure 15. This makes a cubical wooden frame within which the trap netting can be tied for support and stretching.

Collecting assembly. The collecting assembly is a metal, screen, and plastic cage and funnel at the top of the trap as in figure 21. Figure 16 shows the assembly in detail and figure 17 shows the metal framework from underneath view. Besides its collecting function, this assembly holds up the center peak of the trap and is in turn supported by the center pole. For construction, rivet together parts A, C, D, and G as in figures 16 and 17, using 3/16″ aluminum rivets, ⅜″ long. Next place part H on this framework, bending it into the shape of a bent-over cone as shown in figure 16. Fasten the overlapping edges with heavy wire staples from a stapling machine by inserting the prongs manually through the meshes of the screen and manually clinching the ends. Then fasten the screen cone to the metal frame by lapping its lower edge ½″ over the circular band (part A) and bolting a circular strap (part B) over this, as in figure 16. Next bolt on part E as in figure 16.

The plastic cone is made from parts I, J, and K. Overlap the edges of part I so that the holes in each edge and the submarginal scratches exactly overlap, smear between the overlapped edges with glue made by dissolving plastic scraps in acetone, and clamp the edges into place between wood strips ½″ wide, held with c-clamps. When the glue has hardened, take off the clamps, lay a sheet of medium fine sandpaper on a flat surface, and rub the wider mouth of the plastic cone over the sandpaper till the edges are even and beveled to a single plane. Then smear these edges with the plastic glue and invert and center the cone over the plastic square (part J). Place with the square piece down on a flat surface, balance a weight on the top of the cone, and leave till the glue is hard. Trim the overlapping edges of the plastic square (part J) with tin snips, pocket knife, and sandpaper. Place the metal screw cap (part K) over the small end of the cone as in figure 16. Then place thick glue made of the plastic dissolved in acetone over the joint between the jar lid and the plastic cone, both top and bottom sides. Screw the pint jar (part L) into the jar lid to press away excess glue, remove the jar, and let the glue harden. Now bolt the cone to piece E on the assembly. The opening of the screen cone should be adjusted to fit as closely as possible to the edges of the hole in the side of the plastic cone. If there are any gaps through which insects could escape, plug them by stuffing in a pledget of cotton. Lastly, pass the iron bar (part F) through the center hole in part G and bolt it at the top as in figure 16.

Netting. Sew the zipper (part S) into the center line of one of the top panels (part M), as shown in figure 22, and slit the panel along the zipper so it will open. Sew together edges of all four of top panels (parts M) as shown in figure 22. Use binding tape on top and bottom of each seam as diagrammed in figure 18, one tape on top and two on the bottom. If the netting is stretchable, it will be necessary to pin or baste it to the tapes before sewing. The two bottom tapes are left with one edge free for later insertion of part N. When the top panels are sewn together a four-sided pyramid with a hole at the center results. Put the center hole over a cushion or a wad of cloth to fill it out, center the ring made by part B over the hole, and with a soft crayon mark an 8¼″ circle on the netting, inside the ring. With scissors cut from the center opening out to this crayon-marked ring all around the circle at intervals of about 1″. With a piece of cord ⅛″ to 3/16″ in diameter and 28″ long make a circle of 8¼″ diameter by circling the outside of piece B in the collecting assembly with the string, and sewing the overlapped ends together with needle and thread. Place this circle of cord on the crayon mark on the center of the four top panels, turn the tabs just cut back over the cord, pin them in place with straight pins, and stitch them down with the sewing machine. After removal of the pins this makes a circular opening with a corded edge for attachment of the trap to the bottom of the collecting assembly. Next, cut twelve 6″ lengths of binding tape and fasten them as loops to the four corners of the assembled parts and at ten inches from each corner, as in figure 22.

Pass the hole in the top of the trap top over the lower part of the circular strap (part A) of the collecting assembly. Rotate the collecting assembly till its plastic cone is directly over the zipper that has been sewn into one of the panels, and then with a circular strap (part B) bolt and clamp the netting to the collecting assembly. The edge of the corded circle should lie in the ¼″ crack between the upper and lower clamps (parts B).

Take the trap as thus far assembled to the assembled supporting frame (figure 15). Using strong cord tie the trap by its corner loops of binding tape to the four top corners of the supporting frame, the collecting assembly topside.

From beneath, slip the hole in the end of the center pole (part X) over the central iron bar in the collecting assembly and raise the pole to a vertical position. This stretches the netting into a pyramidal roof. Adjust the netting within the frame till all sides are smooth and tight.

Take both of the top baffle pieces (parts N) and sew them together on their midlines. Pin the top baffles into the stretched roof, placing the long oblique edge of the pieces between the free edges of the binding tapes sewed to the underside of the junctures of the top panels. Adjust the pinning until the baffles are smoothly stretched to each outer corner. Then take the netting out of the supporting frame, take the collecting apparatus off of the netting, and sew the baffles into place where they have been pinned. The bafflles need to be pinned into place in the above routine before sewing, if a smooth job is to result.

Sew the two bottom baffle pieces (parts O) together along their midlengths. Match these baffles with the top baffles at their sewn midlines and pin and then stitch the top and bottom baffles together along their respective lower and upper edges.

Crease the four side baffle pieces (parts P), lengthwise along their middles, and place and pin each with its middle creases over the outer edges of the bottom baffles (parts O), one at each of the trap corners. Sew along the pinned creases to attach the side to the bottom baffles, as in figure 23. Next sew the upper edges of the side baffles to the adjacent edges of pieces M. Cut 12 pieces of binding tape each 6″ long and sew them as loops to the lower corners of the side baffle pieces as in figure 21. These are for stretching and tying down the lower corners of the trap.

Sew the bottom skirt pieces (parts R) to the lower edges of the bottom baffle. These pieces hang loose from the bottom of the trap. They are not shown in the figures. Lastly, reattach the netting to the collecting assembly, as was done for pinning in the baffles, placing the iron pin (part F) in the same baffle corner as previously.

The design is for a trap with two baffles crossed in the middle. Another good baffle design, better for some situations, is two side baffles and one across the middle, as in figure 19. Directions for this are not given, but how to make it should be obvious.

Operation

The trap is designed for portability. Setting it up or taking it down requires about 30 minutes (after practice). The supporting frame collapses into two bundles of sticks and the rest of the trap can be folded into a box approximately 12″ x 12″ x 24″. The pint jar on the collecting assemby is the final resting place of the insects caught. It can be filled about 10% to 50% full of alcohol (70% to 95%) for killing and preserving the insects or can be fixed as a cyanide jar. Alcohol has the advantage that the specimens will be safe for several days if the trap cannot be emptied daily, and because leakage of rain into the jar does not cause trouble. (Rain could be entirely kept out, however, with a small plastic shield around the collecting cone.) Alcohol is preferred for most insects and is usable for all, including Lepidoptera. Malaise used ethyl acetate for a killing agent in his original design. The fumigant was in a small bottle in the bottom of the collector and was dispersed by a wick. Ethyl acetate should work very well in the present trap design, except that it will dissolve cellulose acetate plastic. If this killing agent is used, a plastic insoluble in ethyl acetate should be substituted.

It is not always necessary to use the supporting frame, as the trap can be stretched between bushes or stakes, but the frame is a great convenience and makes a tidy set-up. When in place the trap should be securely tied down with a strong cord at each corner, or heavy rocks placed on the lower rails of the frame. Otherwise a gust of wind will tip it over. The zipper in the roof of the trap is for easier access to the collecting jar. Without opening the zipper, the jar is a long reach for a short person.

Placing the trap is all-important. Among trees and bushes in a rich moist area is best for a good catch, but sometimes the collector will want to set it in less likely places to see what occurs in the more rigorous habitats. Malaise (1957, Ent. Tidskr. 58: 148-160) gives some pertinent pointers on placing traps. The side of the trap with the zipper and jar should be towards the side with the most light, or in open country probably toward the southwest. The trap is best emptied daily if alcohol is used, every few hours if cyanide is used.

Early in the season, while insects are flying low because the warmest air is near the ground, or when set in short vegetation, the above trap model is too high for efficient collecting. For such conditions a lower trap can be made or this same trap can be set lower, only half way up in its supporting frame, and the center pole either sawed off or its lower end put in a hole.

For Ichneumonidae, four traps can equal the efforts of one good collector, but the average collector is bested by a single trap and no collector works all day every day, as a trap does. In southern Michigan, 6,000 ichneumonids is the expected season's catch for a trap at a moderately good site. Ichneumonids make up about 5% of the total catch. More than half are Diptera.